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PICATINNY ARSENAL TECHNICAL DIVISION



TECHNICAL REPORT

**SUBJECT: EFFECT OF THE EXPLOSIVE CHARGE SURROUND-
ING THE FUZE WELL LINER ON THE FRAGMENTA-
TION OF THE 75 MM T50E2 HE SHELL.**

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**ORDNANCE
PROJECT NO. TA1-1254A**

**DEPT. OF THE ARMY
PROJECT NO. 504-03-010**

PREPARED BY: A. J. PASCAZIO

DATE: MARCH 1954

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EFFECT OF THE EXPLOSIVE CHARGE
SURROUNDING THE FUZE WELL LINER ON THE FRAGMENTATION
OF THE 75 mm T5OE2 HE SHELL

by

A. J. Pascazio

March 1954

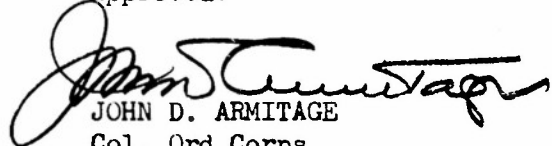
Picatinny Arsenal
Dover, N. J.

Technical Report 2007

Ordnance Project TA1-1254A

Dept of the Army Project 504-03-010

Approved:


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OBJECT

To determine the effect Composition B surrounding the fuze well liner has on the fragmentation characteristics of the 75 mm T50E2 HE Shell.

SUMMARY

Fragmentation tests have been conducted on 75 mm T50E2 HE Shell, loaded with Composition B, to determine the effect on fragmentation when the charge does not surround the fuze well liner. The pit fragmentation tests were performed at this Arsenal, and the panel fragmentation tests were performed at Aberdeen Proving Ground. Both tests were run on shell with and without the explosive charge surrounding the fuze well liner.

Results of the tests showed an appreciable decrease in fragmentation efficiency of the shell when the explosive does not surround the liner. The panel fragmentation tests also showed that shell loaded with Composition B without the explosive surrounding the liner were more effective than shell loaded with TNT with the explosive surrounding the liner.

CONCLUSIONS

Fragmentation is decreased when the explosive, Composition B, is not surrounding the fuze well liner of the 75 mm T50E2 HE Shell.

For best fragmentation results, the use of Composition B in this shell, with or without the explosive collar around the liner, is preferable to the use of TNT loaded shell.

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INTRODUCTION:

1. Previous tests have proven that Composition B produces more fragments moving at greater velocity than those produced by TNT loaded in the same item. Therefore, in the development of the 75 mm T50E2 Shell for use in the T83 Gun, Composition B was selected as the explosive charge.

2. Four prematures were found when 80 Composition B loaded T50E2 Shell (Lot PA-E-9413) were safety tested by firing at ambient temperature and excess pressure at Yuma Test Station (Ref A). Since M51A5 Inert Fuzes were used with the shell, it is probable that the prematures were caused by either the filler or the shell metal parts.

3. To determine the cause of the prematures, a comprehensive program was undertaken to study the specific shell metal parts of this lot and the various characteristics of the Composition B filler. As one part of the investigation of filler, it was decided (Ref B) to investigate the effect of the explosive collar surrounding the fuze cavity or supplementary charge well; it was believed that this collar might be a cause of the prematures in that it might be breaking or crumbling on firing.

RESULTS:

4. Six T50E2 Shell loaded with Composition B were subjected to pit fragmentation tests. Three of the shell were loaded in accordance with Drawing 75-14-634 revised August 11, 1951 (Fig 1). The other three were loaded so that the surface of the Composition B charge was 4.94 ± 0.05 inches from the top of the shell; this eliminated the explosive collar surrounding the fuze well. The shell loaded in accordance with Figure 1 produced an average total of 3068 fragments, and the shell loaded without the explosive collar produced an average total of 2508 fragments. The results of these tests are given in detail in Tables 1 and 2. Figures 2 and 3 show fragments from typical shell.

5. Fifteen T50E2 HE Shell were subjected to panel fragmentation tests. Six of these shell were loaded

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in accordance with Figure 1 (with collar); six were loaded with Composition B so that the top surface of the explosive charge was 4.94 ± 0.05 inches from the top of the shell (without the collar); and three were loaded in accordance with Figure 1, except that TNT was substituted for Composition B as the filler. Details of the tests are given in Table 3; a summary of the results follows:

a. Six shell loaded with Composition B, three with the collar and three without, were assembled with a standard TNT supplementary charge and PD M51A5 Fuze. When subjected to a panel fragmentation test, the three shell with the collar gave an average of 204 perforating fragments at a 20-ft radius, and the shell without the collar gave an average of 167 perforating fragments at a 20-ft radius.

b. Six shell loaded with Composition B, three with the collar and three without, were assembled without a supplementary charge and with a T73E9 VT Fuze. When subjected to a panel fragmentation test, the three shell with the collar gave an average of 167 perforating fragments at a 20-ft radius, and the shell without the collar gave an average of 128 perforating fragments at a 20-ft radius.

c. Three shell loaded with TNT with the explosive collar were assembled without a supplementary charge and with a T73E9 VT Fuze. When subjected to a panel fragmentation test these three shell gave an average of 93 perforating fragments at a radius of 20 ft.

DISCUSSION OF RESULTS

6. When subjected to pit fragmentation tests, the three T50E2 Shell loaded with Composition B without the explosive collar produced an average of 18% fewer fragments than the three shell with the collar loaded in accordance with Figure 1. Comparison of the weight of explosive in each type of loading showed that the shell without the explosive collar contained 23% less weight of explosive than the shell with the collar. It was therefore indicated that the decrease in the

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weight of the explosive, due to the absence of the explosive collar around the fuze well liner, resulted in a comparable decrease in the number of fragments obtained.

7. When subjected to panel fragmentation tests, the three T5OE2 Shell loaded with Composition B without the explosive collar and containing a supplementary charge produced an average of 18% fewer perforating fragments than the three shell loaded in the standard manner with the collar. When similar groups of shell were assembled with T73E9 VT Fuzes, the shell loaded without the collar produced 23% fewer perforating fragments than the shell loaded in the standard manner with the collar. The number of perforating fragments at a radius of 20 ft was selected as the basis of comparison. The penetration data, the number of perforating fragments at a radius of 40 ft, the total number of hits, and the average fragment velocity substantiated, in all instances, the general decrease in fragmentation performance obtained from the shell loaded without the collar.

8. It was brought out by panel fragmentation tests that T5OE2 Shell loaded with Composition B without the collar produced an average of 38% more perforating fragments than T5OE2 Shell loaded with TNT with the explosive collar. This indicated the desirability of using Composition B as the filler for this round, even if it were necessary to exclude the explosive collar.

9. Both the pit and the panel fragmentation test results indicated that the explosive collar around the fuze well liner was of value in producing a greater number of fragments and perforations per shell. It was evident that this explosive should be retained in the charge unless definite proof later develop to show that it is conducive to producing prematures.

EXPERIMENTAL PROCEDURE

10. The pit fragmentation tests were conducted at Picatinny Arsenal in accordance with the following procedure: The shell were initiated electrically by means of a PD M54 Fuze modified in accordance with Drawing PX-99-287. The shell were fragmented in boxes

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8" x 8" x 14" (outside dimensions) made of 1/2-inch pine lumber. Each box with a shell was placed on about four feet of sand in a steel fragmentation tub, the detonator wires were connected, and the box was covered with approximately four feet of sand. After the shell was fired, the sand was run slowly onto a gyrating 8-mesh screen. The larger fragments were recovered on the screen while the fragments which passed through were recovered by means of a magnetic separator. The fragments were classified by weight, counted, and photographed.

11. The panel fragmentation tests were conducted at Aberdeen Proving Ground. This test has previously been conducted in accordance with the following procedure: The shell were suspended horizontally at the center of two panels that are formed by vertical, semicircular frames with radii of 20 feet and 40 feet. These frames had the same center and faced one another. The panels were completed by fastening nine-foot lengths of one-inch white pine boards around the frames. For the first half of the test the loaded shell were assembled with standard TNT supplementary charges and fuzed with PD M51A5 Fuzes modified for static firing. For the second half of the test the loaded shell were fuzed with VT T73E9 Fuzes (without supplementary charges) modified for static firing. The PD M51A5 and VT T73E9 Fuzes were detonated electrically by means of Type II US Army Special Blasting Caps inserted into the modified fuzes (Ref C).

REFERENCES:

A. 1st-4th, inclusive, Memorandum Reports on Test of Cartridge, HE, Comp B, T50E2, for Gun, 75 mm, T83E1, from HQ, 9301 TSU (ORD) Climatic Test Detachment, Yuma Test Station, Yuma, Arizona dated 9 February, 19 March, 25 August and 29 July 1953, respectively.

B. 00471/1279 (75 mm) (C); ORDBB 471.12/104; July 1953

C. APG Firing Record No. P-43985

INCLOSURES:

1. Figures 1 through 5

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PICATINNY ARSENAL FRAGMENTATION TEST

Projectile: 75-mm, T50E2, Lot PA-2-41 CONFIDENTIAL Test Record No: 218

Explosive Filler: Comp B w/supplementary Shg. (TNT)

Sheet 1 of 2

Type Fuze: ~~W/Comp B surround~~
PD M54, Mod in accordance w/dwg

Date: 1 Sept 1953

Size of Box: 8" x 8" x 14", 1/2" Pine

Recovery Medium: Sand No. 8 Mesh Screen

Ammo. Lot PA-E-13287

Requested by Mr. A.J. Pascazio			PROJECTILE NO.			
			6	7	8	
Wt. Empty Lbs.			8.43	8.46	8.39	
Wt. Loaded Lbs.			10.22	10.26	10.20	
Number and Weight of Recovered Fragments	No. 0 Group	Through a 10 Mesh Screen (U. S. Std Sieve Series)				
	0 to 1/2 Grs.	Wt. Lbs.				
	No. 1 Group	No.				
	1/2 to 2 Grs.	Wt. Lbs.				
	No. 2 Group	No.				
	2 to 5 Grs.	Wt. Lbs.				
	No. 3 Group	No.				
	5 to 10 Grs.	Wt. Lbs.				
	No. 4 Group	No.				
	10 to 25 Grs.	Wt. Lbs.				
	No. 5 Group	No.				
	25 to 50 Grs.	Wt. Lbs.				
	No. 6 Group	No.	2519	3248	2942	
	50 to 75 Grs.	Wt. Lbs.	3.51	4.29	3.74	
	No. 7 Group	No.	83	103	106	
	75 to 150 Grs.	Wt. Lbs.	1.29	1.55	1.56	
	No. 8 Group	No.	65	62	74	
	150 to 750 Grs.	Wt. Lbs.	3.09	2.42	2.87	
	No. 9 Group	No.	2			
	750 to 2500 Grs.	Wt. Lbs.	.32			
	No. 10 Group	No.				
	2500 and Larger	Wt. Lbs.				
Total No.			2669	3413	3122	
Total Wt. Lbs.			8.21	8.17	8.17	
% of Fragments Recovered			97.3	96.5	97.3	
Photo No.			M43066	M43067	M43068	
CONFIDENTIAL			FIG. 2			

PICATINNY ARSENAL FRAGMENTATION TEST

Projectile: Same

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Test Record No: 218

Explosive Filler: Comp B w/supplementary Chg (TNT)

Sheet 2 of 2

Type Fuze: Same w/o Comp B surround

Date: 1 Sept 53

Size of Box: Same

Recovery Medium: Same

Ammo. Lot PA-E-13286

PROJECTILE NO.

			48	49	50		
Wt. Empty Lbs.			8.48	8.46	8.48		
Wt. Loaded Lbs.			9.84	9.82	9.87		
Number and Weight of Recovered Fragments	No. 0 Group	Through a 10 Mesh Screen (U. S. Std Sieve Series)					
	0 to 1/4 Grs.	Wt. Lbs.					
	No. 1 Group	No.					
	1/4 to 2 Grs.	Wt. Lbs.					
	No. 2 Group	No.					
	2 to 5 Grs.	Wt. Lbs.					
	No. 3 Group	No.					
	5 to 10 Grs.	Wt. Lbs.					
	No. 4 Group	No.					
	10 to 25 Grs.	Wt. Lbs.					
	No. 5 Group	No.					
	25 to 50 Grs.	Wt. Lbs.					
	No. 6 Group	No.	1994	2424	2574		
	50 to 75 Grs.	Wt. Lbs.	2.71	3.66	3.50		
	No. 7 Group	No.	71	102	113		
	75 to 150 Grs.	Wt. Lbs.	1.07	1.49	*		
	No. 8 Group	No.	94	71	67		
	150 to 750 Grs.	Wt. Lbs.	3.88	2.54	2.58		
	No. 9 Group	No.	5	2	6		
	750 to 2500 Grs.	Wt. Lbs.	.64	.22	.74		
	No. 10 Group	No.					
	2500 and Larger	Wt. Lbs.					
Total No.			2164	2599	2760		
Total Wt. Lbs.			8.30	7.91	*		
% of Fragments Recovered			97.8	93.4			
Photo No.			M43069	M43070	CONFIDENTIAL		
			FIG. 2 CONT'D				

* NOTE: Total weight of group not given because a portion of sample was inadvertently lost before weight could be obtained.

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Chief, Proof Testing Unit

Approved by: L. F. PAGE
Chief, Testing Section

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75MM, T50E2, WITH VARIOUS FILLER ARRANGEMENTS

CLASSIFICATION: Restricted

PROJECT NO.: TAL-1254

OBJECT OF TEST: To Obtain Panel Fragmentation Characteristics of Shell, 75mm, T50E2, with Various Filler Arrangements and Fuzes.

Three (3) rounds each of the following shell with various filler arrangements and fuzes have been fired.

Shell	Explosive	Fuze
75mm T50E2	Comp. B Loaded, w/explosive collar surrounding TNT Supplementary Chg.	PD M51A5
75mm T50E2	Comp. B Loaded, w/out exp. collar surrounding TNT Supplementary Chg.	PD M51A5
75mm T50E2	Comp. B Loaded, with Explosive Collar Surrounding VT Fuze	VT T73E9
75mm T50E2	Comp. B Loaded, without Explosive Collar Surrounding VT Fuze	VT T73E9
75mm T50E2	TNT Loaded, with Explosive Collar Surrounding VT Fuze	VT T73E9

PANEL AND VELOCITY DATA

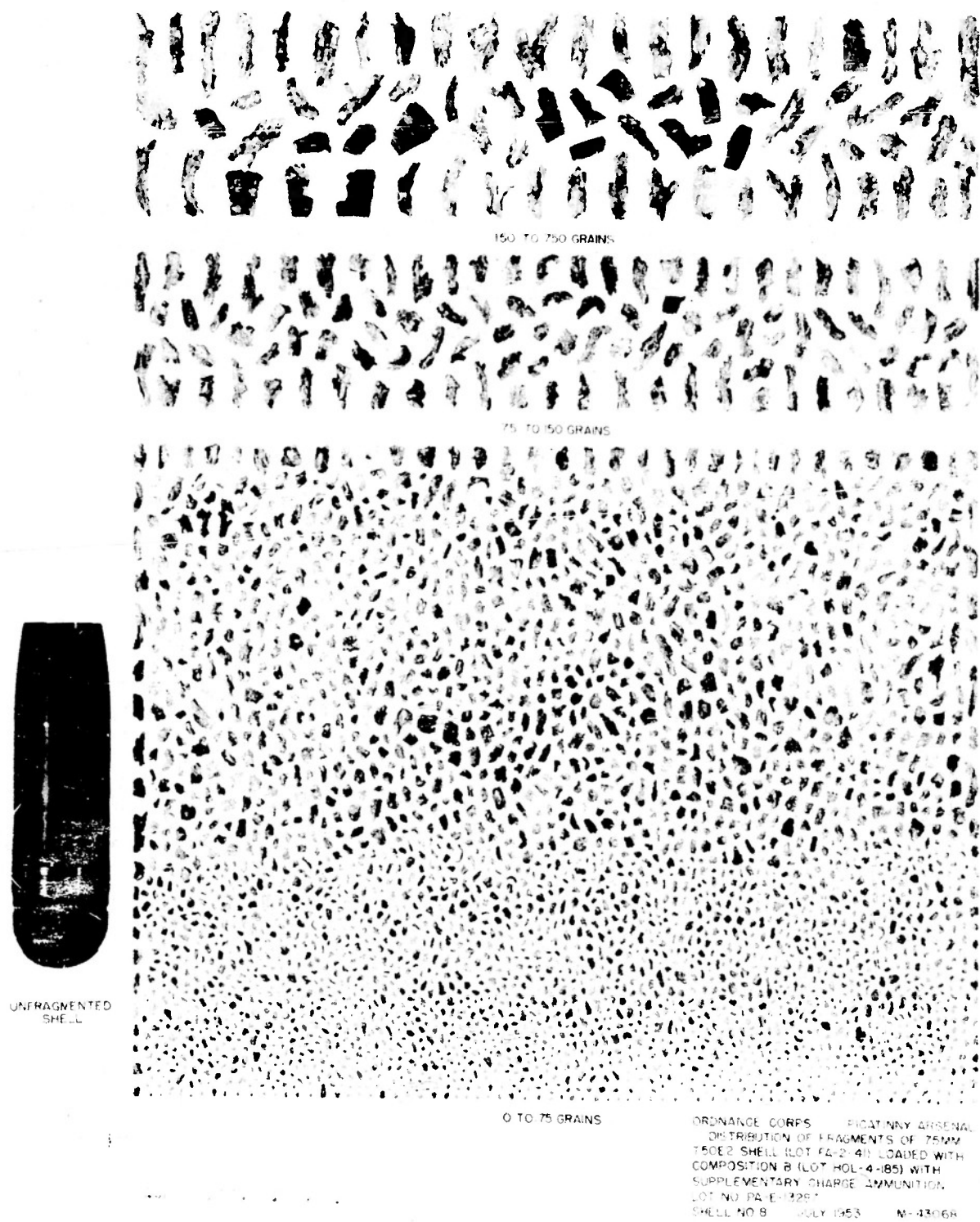
20 FOOT RADIUS			40 FOOT RADIUS					NO. PERFS. IN NOSE	
RD. NO.	PERFS.	PENES.	TOTAL HITS	PERFS.	PENES.	TOTAL HITS	AVERAGE VELOCITY	AVE. FRAG. WT.	AREA OF THE PANELS
									20 FOOT RADIUS 40 FOOT RADIUS
1. Shell, HE, 75mm, T50E2, with standard Composition B. Loading and explosive collar surrounding Supplementary Charge; with Fuze PD M51A5.									
1	225	310	535	60	137	197	3690	32.43	15 5
2	194	347	541	79	136	215	3645	37.16	11 5
3	192	283	475	62	163	225	3644	33.84	13 3
MEAN	204	313	517	67	145	212	3660	34.48	13 4.3
2. Shell, HE, 75mm, T50E2, with standard Composition B Loading without explosive collar surrounding Supplementary Charge; with Fuze PD M51A5.									
4	147	240	387	47	84	131	3094	30.93	3 4
5	182	246	428	62	139	201	3031	43.20	4 5
6	171	189	359	55	96	151	3137	41.04	2 2
MEAN	157	225	391	55	106	161	3087	38.39	3.0 3.5
3. Shell, HE, 75mm, T50E2, Composition B Loading with explosive Collar surrounding VT Fuze, T73E9.									
							*Approx. Average Velocity		
7	Only fuze functioned.								
8	173	372	545	59	137	196	2990	47.50	9 6
9	173	421	594	51	97	148	3010	51.50	8 8
10	157	335	492	58	193	251	2925	40.02	9 5
MEAN	157	376	543	56	142	198	2975	46.34	8.7 6.3
4. Shell, HE, 75mm, T50E2, Composition B Loading without Explosive Collar Surrounding VT Fuze, T73E9.									
11	135	264	399	51	116	167	2835	24.89	13 5
12	101	252	353	44	130	174	2910	30.97	10 5
13	149	287	436	51	133	184	LOST	34.70	14 4
MEAN	128	268	396	49	126	175	2873	30.19	12.3 4.7
5. Shell, HE, 75mm, T50E2, TNT Loaded with Explosive Collar Surrounding VT Fuze, T73E9.									
14	94	199	293	18	77	95	2440	80.11	11 1
15	96	172	268	30	111	141	2520	84.29	3 2
16	88	175	263	25	86	111	2625	126.00	4 1
MEAN	93	182	275	24	91	115	2528	96.80	6.0 1.3

* Plus or minus 200 feet per second.

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FIG. 3

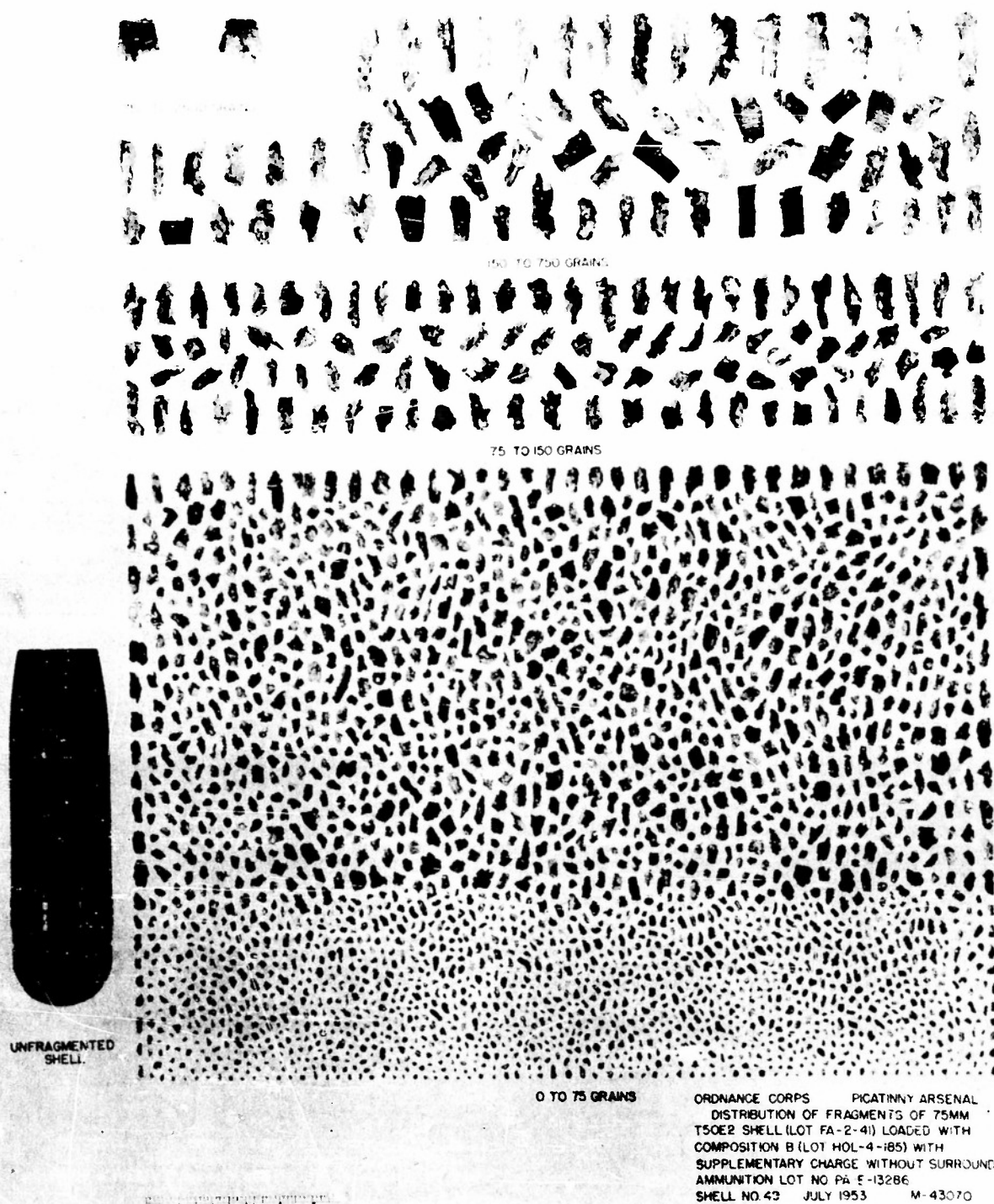
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FIG. 4

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FIG. 5

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